



I want to thank Chris Crumbly for the kind introduction, and David Brock and the Marshall Small Business Association for inviting me to tell you about Marshall's Engineering Directorate.

Dan is at the Jet Propulsion Laboratory, leading a benchmarking study, and regrets not being able to be with you today.

The Marshall Small Business Alliance is an impressive organization and we consider this our chance to thank you — our contractor workforce — for helping Engineering, Marshall, and NASA deliver maximum value for America's space program investment.

I hope the animation helps you better understand NASA's next-generation exploration architecture and the launch vehicles being developed at Marshall by the Engineering Directorate and its partner the Ares Projects Office.

At the end of my presentation, I will introduce our procurement officer and small business coordinators who are embedded throughout Engineering.

We will be available after the meeting ends if you have questions.



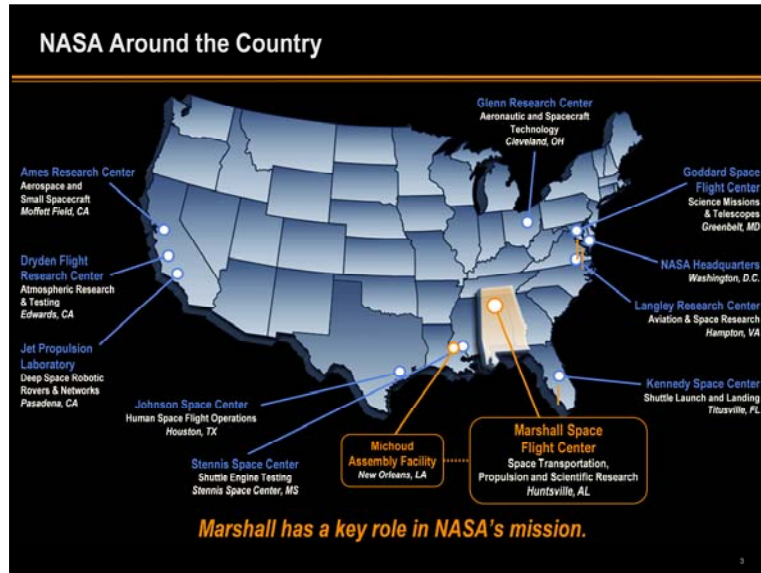
These are NASA's strategic goals, and the Engineering Directorate supports them all.

Today, I am going to talk about two things: (1) our major product lines, and (2) how the Engineering Directorate is organized to deliver technical excellence within budget and on schedule.

It's an exciting time to be at NASA. We're at a defining moment in our history where a time of change is upon us. We are poised once again at the forefront of a technological boom, as we once again look to the Moon and beyond.

As currently planned, we are preparing to retire the Space Shuttle after we complete the International Space Station.

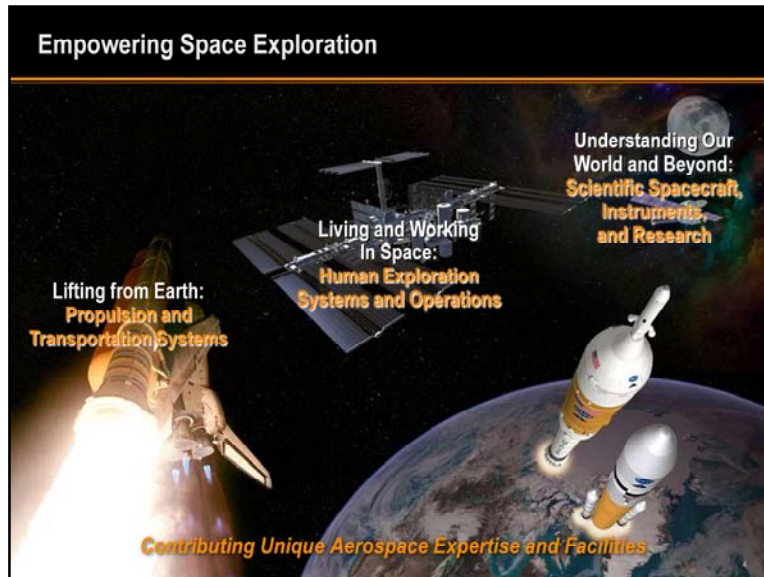
We are already engaged in developing a robust, multipurpose space fleet that will once again take Americans out beyond Earth orbit — and on to the Moon and beyond.



This shows where NASA Centers are located across the country, as well as the specialty of each center.

Marshall partners with other NASA centers, as well as private industry and academia.

One of Marshall's unique roles is the management of the Michoud Assembly Facility in New Orleans, where the Shuttle's external tank is built. Michoud is among the world's largest manufacturing sites and is preparing to produce parts of the Ares rockets.



These are Marshall's three major product lines.

The Engineering Directorate is Marshall's largest organization, with around 2,600 civil service and contractor employees.

I will step through a few slides that go into more detail about each of these focus areas so that our Engineering org chart will make more sense and, perhaps, give you insight into how your company's capabilities might fit in.

But, I want to be realistic in setting your expectations:

NASA's \$17 billion annual allocation is less than 1 percent of the Federal budget, and it has been on a flat line for several years.

It is also important to remember that NASA executes policy and its mission budgets are enacted into law; in this way, we perform work that is relevant and reflects the public will.

So, despite a major administration change, we continue to work the plan that is in place as we await further direction.



The Engineering Directorate developed and sustains the Space Shuttle's propulsion elements, including the external tank, space shuttle main engines, and the solid rocket boosters.

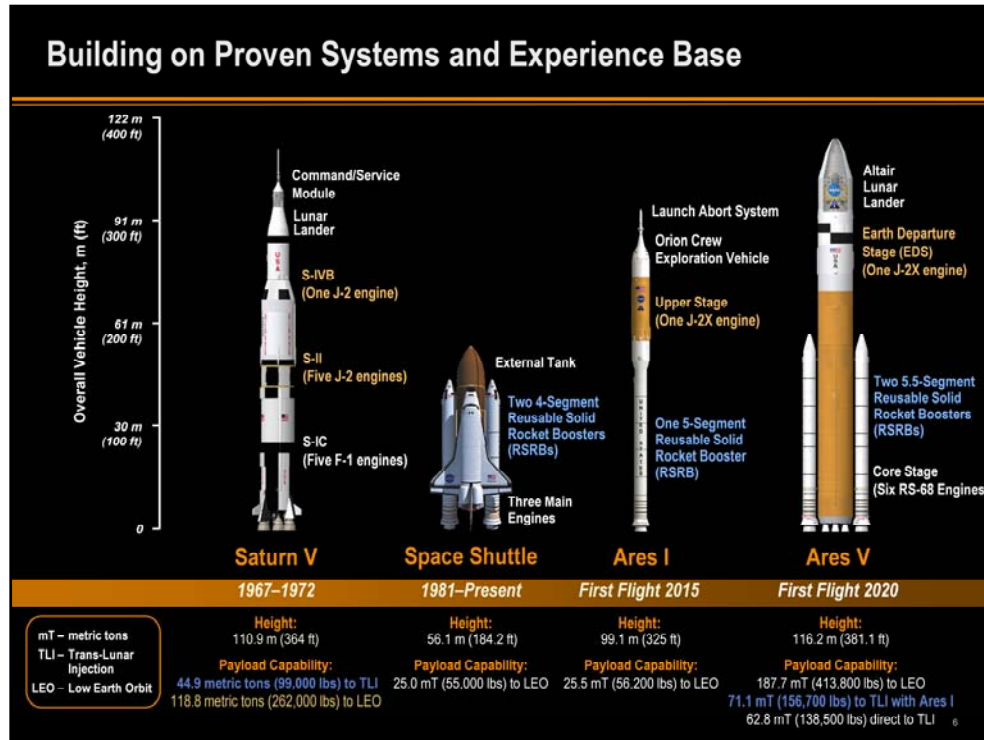
The aging shuttle, which has been flying for nearly 30 years, has facilitated ground-breaking scientific research and given rise to countless technologies, and our goal is to continue flying it safely until it is retired.

Now, we are fully engaged in designing and developing America's new rockets: the Ares I for crew transport and the Ares V to deliver cargo. Together, as we saw in the animation, these two systems will replace the Shuttle and provide more capacity than the Saturn V that first carried Americans to the Moon in 1969.

To clarify roles, Engineering is responsible for technical performance, while the Ares Projects Office provides schedule and budget resources, as well as conducts procurements through the Constellation Program Office at NASA Headquarters; over a billion dollars in contracts have been awarded to date.

For us, it's about the "why" of the journey as much as the "how". Sustainable space transportation solutions are the foundation of long-term and long-range space exploration.

Engineering is also responsible for the technical performance of many science missions managed by Marshall.



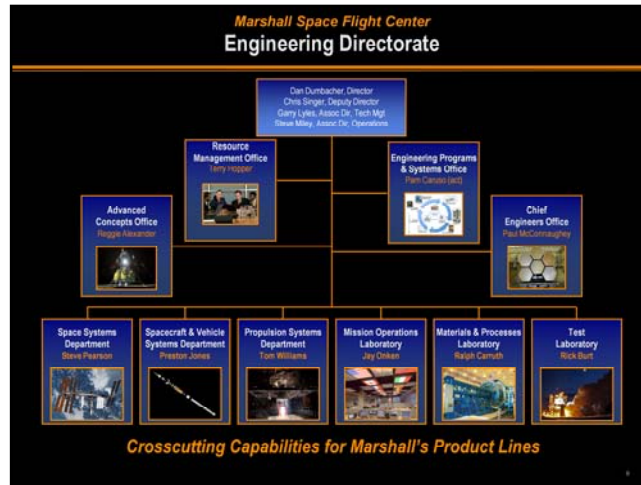
- This chart is a history lesson showing Marshall's unique place in NASA and the world — Engineering has made space flight a national asset by delivering hardware and software for America's human-rated launch vehicles.
- This slide compares the Ares I and Ares V to the Shuttle and Saturn V in height, lift-off weight, and payload capacity.
- For lunar missions, the Ares I combined with the Ares V will put 40% more mass on the Moon than was possible during the Apollo Program.
- Engineering provides both the workforce and the unique aerospace facilities — such as industrial manufacturing capabilities for large structures and test stands that can handle the most powerful engines — to deliver next-generation systems built for safety, reliability, and affordability.



- Engineering plays an essential role in the Space Station, which is a proving ground for the long-term exploration of space, as well as a science platform.
- The ability to operate 24 hours a day, 7 days a week in the Payload Operations Center, using advanced information systems that can handle an enormous volume of data, grew from our early capabilities.
- Engineering built the Regenerative Environmental Control and Life Support System that provides a safe and comfortable environment for the crew.
- Through the Shuttle Program, we installed the Oxygen Generation System in 2007 with the first ever production of oxygen in space by the United States.
- We installed the Water Recovery System last year.
- When these systems are fully operational, the Station will be able to support a six-person crew and the amount of science we can perform will increase by orders of magnitude.
- Marshall engineers also developed the Microgravity Science Glovebox (MSG), equipment that is an evolution of the Glovebox that first flew in the Shuttle's Spacelab.
- The Materials Science Research Rack will provide a multi-user science lab in the microgravity environment in space. The MSRR is complete and will fly to the Station in 2009.
- While we plan for early Ares I missions to the Station to rotate crews, NASA has invested in development of private launch vehicles to service the Station in years to come through the Commercial Orbital Transportation System (COTS).
- Perhaps that Station's most important role has been to unite countries for the peaceful pursuit of exploration.



- While the human exploration of space gets a lot of attention, NASA has a balanced portfolio of robotic and autonomous space missions, including space telescopes and the suite of Discovery and New Frontiers Program missions.
- Combining robotic and human capabilities offers us the best chance to discover new knowledge that has direct benefits on Earth.
- Engineering is a partner with Science and Mission Systems, providing a network of senior personnel and systems engineers to deliver systems for scientific discovery.
- Robotic missions managed by the Lunar Precursor Robotic Program located at Marshall will lead the way back to the Moon. Engineering supports these missions as well.
- The first step in our return is the 2009 launch of Lunar Reconnaissance Orbiter (LRO) and Lunar Crater Observation and Sensing Satellite (LCROSS). These co-manifested missions will gather much-needed information about the lunar environment and provide NASA scientists and engineers with the tools needed to determine the best sites for a lunar outpost.
- Marshall manages the lunar mapping project that will integrate the information collected by LRO and LCROSS with existing lunar data (as well as new information from international lunar missions) to construct the most complete map of the Moon to date.
- NASA is cooperating with other nations to help put in place an International Lunar Network (ILN) infrastructure. Ultimately, this network will consist of 6 to 8 nodes, each carrying a core set of scientific instruments designed to help us understand the Moon's composition and provide details of its origin. Two nodes will be supplied by NASA in 2013/2014 time frame and Engineering is working on those today.
- The Gravity Recovery and Interior Laboratory (GRAIL) is a Discovery mission that will fly twin spacecraft around the Moon to measure its gravity field, which will eventually help scientists better understand the moon's interior structure. Engineering works with the Science Program to develop spacecraft and systems such as this.
- The Lunar Science Program is another of Marshall's Science and Mission Systems responsibilities. The small orbiter mission called Lunar Atmosphere and Dust Environment Explorer (LADEE) and a pair of mini-landers are scheduled to be launched around 2014.



- Now that you have a better understanding of Marshall's product lines, this shows how Engineering is organized.
- As I've shown you, we provide cross-cutting technical services for Marshall's business units, including the Shuttle propulsion projects, Ares rockets, and science programs.
- Engineering is a "brain trust" that is responsive and customer-focused.
- I will give you a brief overview of some of the work that is done in each of our offices, labs, and departments, knowing that our strength comes from integrating the so-called spaces between them.
- This may help you when looking at business opportunities.

Engineering Directorate Capabilities

Advanced Concepts



- Concept Definition, Integration, & Analysis
 - Earth-to-Orbit Transportation
 - In-Space Transportation
 - Planetary Surface Systems
- Mission Analysis
- Architecture Analysis
- Technology Assessments

Space Systems



- Systems Engineering & Integration
- Avionics
- Software
- Electrical Integration
- Mechanical Systems
- Fabrication & Assembly Services
- Environmental Control & Life Support Systems

Spacecraft & Vehicle Systems



- Systems Engineering & Integration
- Tank/Structures Design
- Loads & Dynamics
- Mechanisms
- Terrestrial & Space Environments
- Induced Environments
- Modeling & Simulation
- Guidance, Navigation, & Control

Propulsion Systems



- Propulsion Engineering
- Liquids & Solids
- Component Design
- Fluid Systems Design & Analysis
- Computational Fluid Mechanics
- In-Space Propulsion
- Nuclear Propulsion

Organized for Mission Success

10

- Advanced Concepts begins the process of technical trade studies for products from lunar landers to human-rated rockets. In fact, the Ares I and Ares V had their inception in Advanced Concepts as a natural extension of their work with the Exploration Systems Architecture Study.
- Space Systems is where most of the avionics, software, and environmental control and life support system work is done. [INTRODUCE DONNA HARDAGE]
- Spacecraft and Vehicle Systems is where the Ares upper stage and vehicle integration talent reside. They are located in building 4600, NASA's first certified "green" building. [INTRODUCE NICK DEVILLO]
- Propulsion Systems provides expertise across the range of engine types. They work very closely with Shuttle and Ares. [INTRODUCE TERRY WARE]

Engineering Directorate Capabilities *(continued)*

Mission Operations	Materials & Processes	Test Lab
 <ul style="list-style-type: none"> • Operations Concepts • Ground Systems <ul style="list-style-type: none"> – Design Development – Certification – Operation • Flight Operations <ul style="list-style-type: none"> – Mission Design – Crew Procedures & Timelines – Flight Controller Cert. – On-board Facility Ops 	 <ul style="list-style-type: none"> • Metallics • Composites • Ceramics • Environmental Effects • Fracture & Failure Analysis • NDE & Tribology • Chemistry & Combustion Research 	 <ul style="list-style-type: none"> • Propulsion Testing • Structural Testing • Thermal Vacuum • Shock & Vibration • Acoustic • Experimental Fluids Test & Development • Advanced Instrumentation Application

Organized for Mission Success

- Mission Operations manages the Payload Operations Center for science on the Space Station and has developed the Ares Operations Concept. Recently, they hosted the European Space Agency, which is benchmarking their operations against our capabilities. [INTRODUCE DALE MCELYEA]
- Materials and Processes is home of one of the country's largest welding machines. They work closely with a variety of customers to determine the best materials for the requirements and how to manufacture them in ways that are efficient and cost-effective. They are closely connected with our external tank work at Michoud. Materials and Processes is located in building 4601, our newest Engineering building. [INTRODUCE JOHN VICKERS]
- Our Test Laboratory is probably our most visible asset, with 50 facilities that can generate flight-like data to anchor engineering computer models. As we continue contributing vital data for the Shuttle and Station programs, we have already tested subscale injectors for the J-2X engine, which will power the Ares I and Ares V upper stages. Right now, we are preparing our Saturn-era Dynamic Test Stand for testing the Ares main propulsion test article and the Ground Vibration Test Stand for testing the integrated vehicle stack. [INTRODUCE KAREN MCTAGGART]

Engineering Directorate Capabilities (continued)



- The Resource Management Office is responsible for making sure we operate accountably and within our scope and budget. They do the hard work of planning and allocating our limited resources to accomplish an enormous volume of work.
- Programs and Systems provides the framework for our product lifecycle management initiative, NASA standards, and a variety of tools and processes that result in quality products.
- And last, but not least, our Chief Engineers Office infuses the ideals of technical excellence throughout the Engineering culture. Many Chief Engineers serve as systems engineers and are embedded with our customers.
- Our Procurement Office Rep is David Iosco; all inquiries about Engineering contracts come through him or David Brock.

For More Information



Marshall Space Flight Center
www.nasa.gov/centers/marshall

Doing Business With Marshall
http://ec.msfc.nasa.gov/msfc/doin_bus.html

13

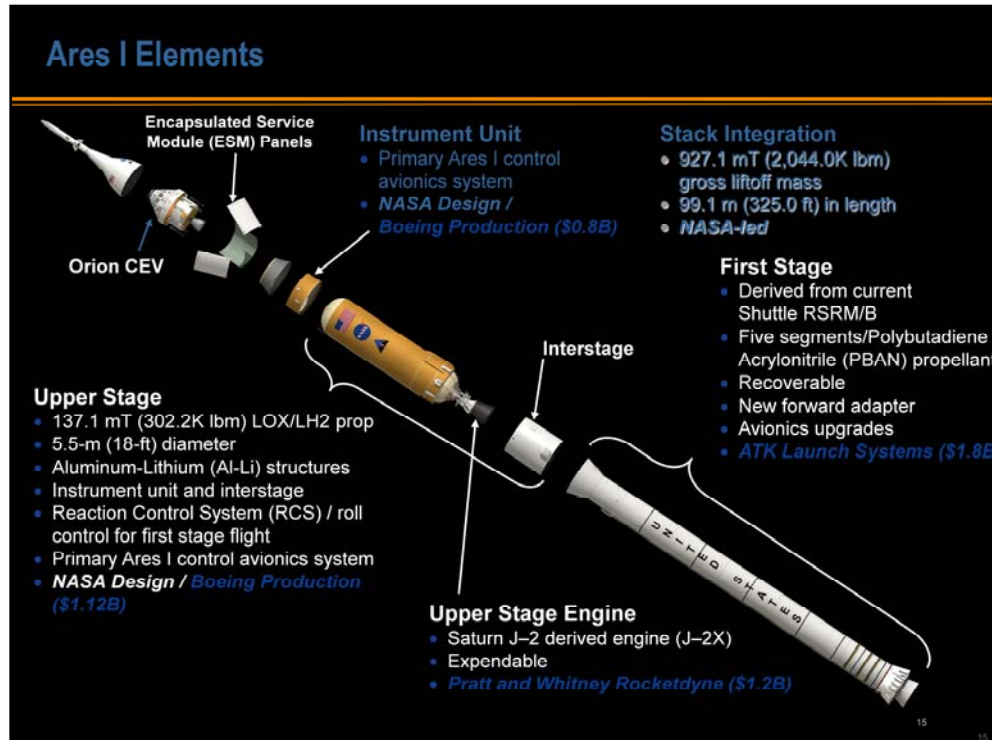
- I hope I have given you a sense of the excitement and vitality within Marshall's Engineering Directorate.
- With your help, we have the opportunity, and privilege, to create a future where our country continues to be globally competitive through its leadership in space.
- Please visit our websites for more information.

After the meeting, our Engineering Coordinators and Procurement Representative will be available to talk with you.

Thanks for your time.

Backup

14



- Over the past 3 years, we have conducted major procurements to put the Ares I vehicle on track for delivery early next decade.
- With a mix of prime contractors and in-house development and integration work, the Engineering Directorate provides many of the facilities and most of the personnel who are engaged in this work.
- This shows a breakdown of the dollar values for major elements such as the first stage, upper stage production, instrument unit, and upper stage engine.